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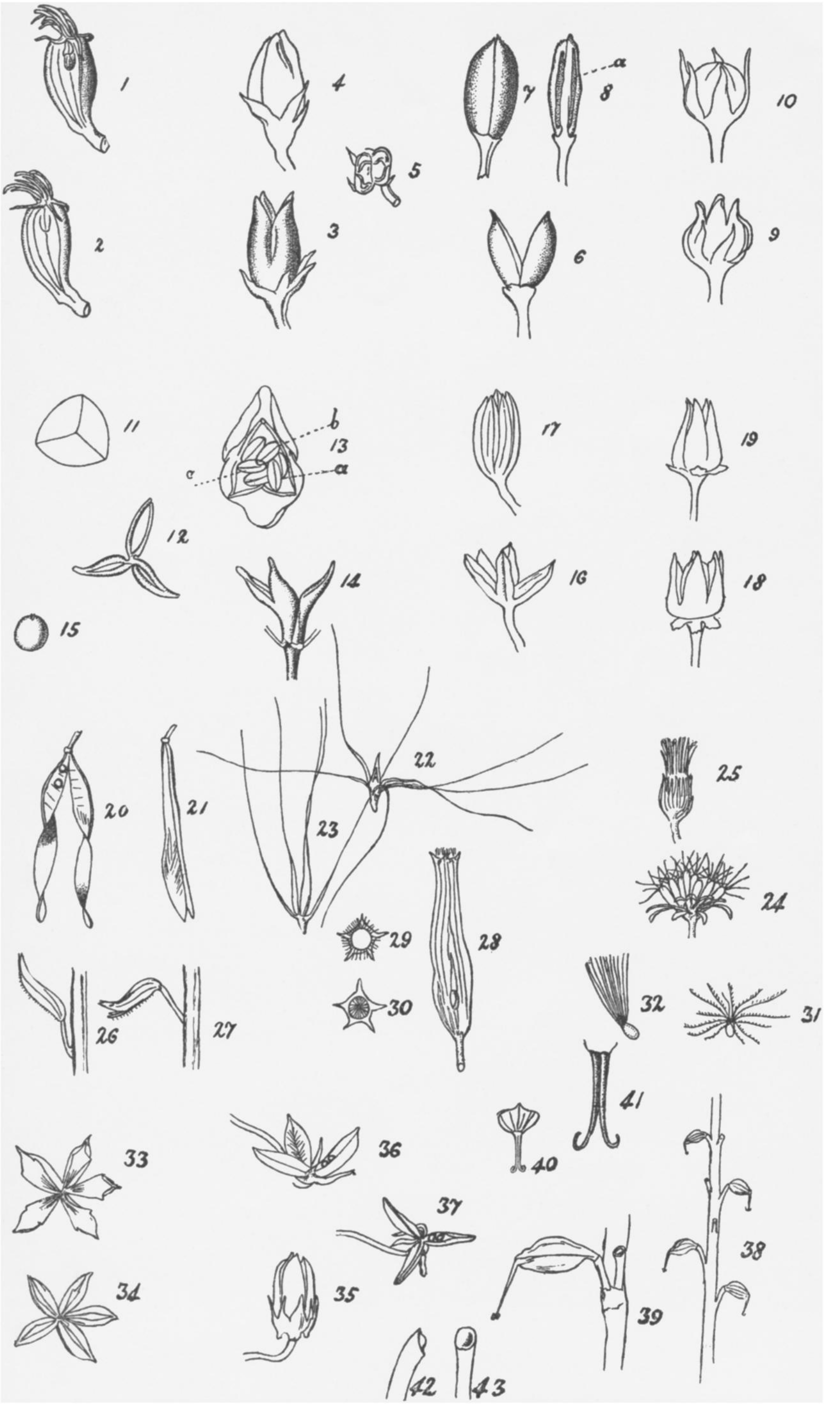
BULLETIN TORREY BOTANICAL CLUB. Plate CXVI.



Influence of Moisture upon Dehiscent Fruits.
B. D. Halsted and D. G. Fairchild.

Influence of Moisture upon Dehiscent Fruits.

By B. D. HALSTED and D. G. FAIRCHILD.

(Plate CXVI).

The changes wrought by moisture and dryness upon the dehiscent fruits doubtless assist in the dispersion of seeds in more cases than at first one is willing to grant. A number of the ordinary fruits have been experimented upon by artificially alternating a moist and dry condition, and the results are abbreviated in the following paper.

In experimenting with the fruits it was found necessary to immerse them in a vessel of water in order to get the most marked results, although evident signs of movement were observed when only a moist chamber was used. The dry conditions were generally supplied by the bright sunlight or in case this was absent, by the use of an oil stove.

In the majority of cases examined it will be noted that the hygroscopic movement is much more rapid upon the absorption of water than upon its evaporation from the fruit; but whether there is any advantage in this to the plant, may be a question.

The capsules of *Campanula Americana*, as noticed by Gray in contradistinction to *C. rapunculoides*, have their valves situated near the top, and in dry weather the flaps curl outward and upward, thus allowing free access to the winds which whistle through the openings and whirl out the light, flat seeds. These flaps uncurl and close in from ten to thirteen minutes when placed in water, but require a much longer time to open when placed in warm dry air—the exact time was not noted, but at least fifty minutes are required (Figs. 1-2).

The hard horn-like capsules of *Veronica Virginica* (Figs 3, 4, 5), are examples of a large class of dehiscent fruits, which open and close quite rapidly; that is, fifteen to twenty minutes in closing, and an hour or more in opening. A few examined belonging to this class, are *Syringa vulgaris*, (Figs. 6, 7, 8), *Steironema longifolium*, (Figs. 9-10), and *Viola palmata* var. *cucullata*.

The various species of Viola* as is well known, eject their seeds by the lateral pressure which the valves exert as they fold lengthwise, but in the case of *Claytonia Virginica,* a much more complicated method of expulsion seems to be necessary (Figs. 11-15). The round, flat seeds, six in number, are arranged systematically in the capsule, and as the valves curl inwardly and press against them, the uppermost one (*a,* Fig. 13), is expelled as soon as the pressure becomes great enough. After the expulsion of the first seed, those remaining are arranged again, "loaded" for a second bombardment, and the seed *b* is shot out. In this way the entire number is expelled from the capsule, the last one by the pressure from the sides of the valves. If ripe specimens of this plant be placed in a dry room on sheets of paper, the rattle of the bombardment can be distinctly heard and the floor will be strewn for several feet with the shining seeds. Singular as it may seem in a case of this kind, where so much force is displayed, moisture seems to have little effect upon the capsules when once dried—perhaps because their office to the plant is performed when the seeds are thrown.

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* For an exhaustive account of the minute structure of these opening valves of *Viola*, consult F. Hilderbrand's " Die Schleuderfrüchte und ihr im anatomischen Bau begrundeter Mechanismus. Pringsheim's Jahrbücher für Wissenschaftlichen Botanik, 1873-4, VOL. ix, pp. 235-276, taf. 1-3.

Hybiscus Syriacus, (Figs. 16, 17), has membranaceous capsules, which are retained upon the plant long after the seeds have been blown away, and the wide and rapid variations in the position of the valves make it a most interesting case; in fact, so pronounced are these changes that after a sharp rain the whole aspect of the plant is notably altered. These capsules are representative of a large class of membranaceous seed vessels, of which *Hypericum Ascyron,* (Figs. 18, 19), and *Dictamnus Fraxinella* (Figs. 33, 34), furnish examples. These capsules close when placed in water, in from five to fifteen minutes, varying with the species and maturity of the pods.

The long, soft pods of the *Asclepiads,* if examined upon a rainy day, will all be found closed or nearly so. The movement, although not rapid is quite marked, on account of the large size of the pods.

From its peculiar curled pods *Cassia Chamæcrista,* (Figs. 20, 21), might be expected to show decided hygroscopic movements; if these open or half-open pods are placed in water, they close in five or six minutes. Although exhibiting this rapid hygroscopic movement, the pods possess no explosive power, as in the case of members of the genus *Phaseolus*.

The awns of many grasses, notably those of the *Stipas* and *Andropogons*, twist and untwist with changes of moisture, but those of *Hordeum jubatum*, (Figs. 22, 23), show very marked movements pointing towards the performance of quite a different office. While the movements of the awns of the Andropogons probably facilitate the entrance of the seed into the ground, those of the "Squirrel-tail" simply serve to separate joint from joint of the dry spike, and aid in their transportation from place to place, like a tumble weed. The movement is simply a lateral straightening or backward curving of the awns, which, wedge-like, raises the spikelet from among those below. Moisture has the effect of quickly reversing the process.

Similar to the last are the movements made by the pappus of numerous species of Compositæ. A sprig of *Solidago Canadensis*, some days past blooming, was placed among others in a glass of water and in five minutes the involucres, which were open as at Fig. 24, had closed in upon the achenia and pappi so completely as to make it almost a matter of doubt if the sprig was the same (Fig. 25). Upon exposure to the dry atmosphere for an hour or so, the involucres opened, and the achenia were soon seen to separate from the receptacle and mount upon each other by the force of the expanding pappus.

The heads of *Brunella vulgaris* are susceptible in a high degree to the changes of moisture. In dry weather the calices with their short pedicels stand closely appressed to the main stem, (Fig. 26), while in wet weather, they bend outward and even downward, (Fig. 27), giving the head a loose, bushy appearance quite different from its aspect in a dry atmosphere.

Upon examining the heads of the common Bergamot (*Monarda fistulosa*), it was found that the dry, tubular calices, which are arranged on branches or arms radiating from the center, are almost always split open at their bases (Fig. 28). At first this almost universal splitting of the calyx, together with the presence of the chinks in the floor of the head, were taken as indicating a regular mode of seed distribution; but further examination showed it to be only a secondary mode at most; the primary one is through the hairy throat. The force which raises the seeds from the bottom of the calyx is centrifugal, created by rapid spring-like movements of the stiff flower stalks ; and on any windy day if numerous heads be examined, seeds may be found wedged among the stiff hairs of the calyx throat, unable to escape. These bristles are capable of rapid hygroscopic movement (Figs. 29-30).

While searching for examples of seed distribution, attention was called for the first time to the richly endowed disbursive powers of *Polygonum Virginianum* (Figs. 38–43). The two long reflexed styles of this plant, which are notably persistent, are extremely elastic when dry and at the same time arranged in such relations to each other, that they form an inverted wedge-shaped space capable of holding, when once inserted, the hair of any passing animal. If slight pressure is brought to bear upon the under side of these strong, persistent styles, the seed suddenly separates from its pedicel and flies to the distance of several feet from the plant. The seed in its passage through the air follows a continuous path without revolutions on its own axis.

DESCRIPTION OF FIGURES. (Plate CXVI.)

No. 1. *Campanula Americana*. Dry.
No. 2. The same thirteen minutes after immersion in water.
No. 3. *Veronica Virginica*. Dry.
No. 4. The same moistened.
No. 5. View from above of dry capsule.
No. 6. *Syringa vulgaris*. Dry.
No. 7. The same moistened.
No. 8. Side view, showing seeds *a*.
No. 9. *Steironema longifolium*. Dry.
No. 10. The same fifteen minutes after being placed in water.
No. 11. Green pod of *Claytonia Virginica*, seen from above.
No. 12. The same dry, after seeds have been thrown.
No. 13. The pod ready for dispersion of seeds : *a*, *b*, and *c*, seeds first, second, and third, in order of expulsion.
No. 14. Side view of pod after expulsion of the seeds.
No. 15. Side view of seed.
No. 16. *Hybiscus Syriacus*. Dry.
No. 17. Same in water fifteen minutes.
No. 18. *Hypericum Ascyron*. Dry.
No. 19. Same in water five minutes.
No. 20. *Cassia Chamæcrista*. Dry.
No. 21. Same immersed in water six minutes.

No. 22. Spikelet of *Hordeum jubatum*. Dry.
No. 23. Same in water three hours.
No. 24. *Solidago Canadensis*. Dry.
No. 25. Same immersed in water five minutes.
No. 26. Calyx of *Brunella vulgaris*. Dry.
No. 27. The same wet.
No. 28. Calyx of *Monarda fistulosa*, showing slits near the base.
No. 29. The same seen from above when dry.
No. 30. The same when wet.
No. 31. Achenia of *Cnicus altissimus*. Dry.
No. 32. The same wet.
No. 33. *Dictamnus Fraxinella*. Dry.
No. 34. The same immersed in water fifteen minutes.
No. 35. *Viola palmata* var. *cucullata*. Very wet.
No. 36. Same drying out.
No. 37. Same very dry.
No. 38. Portion of spike of *Polygonum Virginianum*, showing fruit.
No. 39. Same, showing arrangement of fruit enlarged.
Ny. 40. End view of fruit with persistent styles.
No. 41. Styles enlarged.
No. 42. Side view of pedicel, showing peculiar modes of attachment.
No. 43. Front view of the same.

Notes from Pennsylvania.

At my solicitation, J. K. Small and A. A. Heller, students of Franklin and Marshall College, visited Lycoming County, Penn., on the 20th of last August, in order to search for *Asplenium fontanum*, L. along Lycoming Creek, where it was found by McMinn. The cliffs on the east side of the stream were explored for a distance of twelve miles, but without success. Those on the west side, not easily accessible on account of high water, were left for future examination.

From this point the young botanists proceeded to Luzerne County and spent the two following days about one of those little lakes or ponds, so common on the great mountain-plateau of N. E. Pennsylvania. Here they obtained a fine prize in *Aster concinnus*, Willd., and, had they then been aware of the fact, would have brought away a full supply. Mr. McMinn (not " Minn," as printed in the Synoptical Flora) was a civil engineer, who resided many years in Williamsport and collected the rarer plants of the region round about that city, as well as of the counties further west. He was the first, after the time of Muhlenberg, to meet with this *Aster* in its native haunts, and